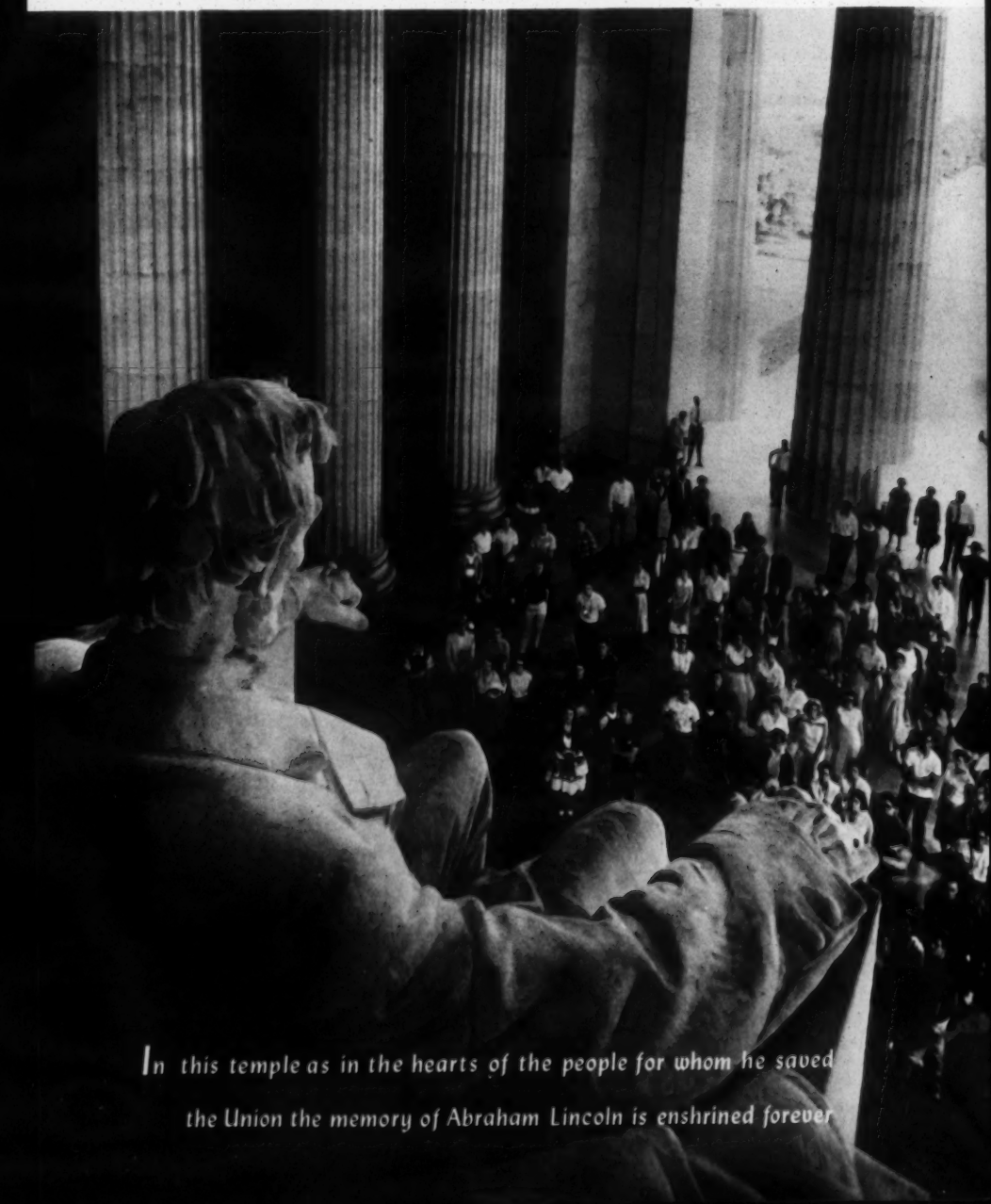
GEOGRAPHIC SCHOOL BULLETINS

THE NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON 6, D. C.

FEBRUARY 8, 1960, VOLUME 38, NUMBER 17 . . . *To Know This World, Its Life*



In this temple as in the hearts of the people for whom he saved the Union the memory of Abraham Lincoln is enshrined forever

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rolling along the biggest, best, most beautifully designed, and safest highways ever built. Paid for by an additional gasoline tax, they're toll-free.

More than 5,000 miles of this supersystem are now open to traffic, and when the 41,000-mile network is complete (the law calls for 1969) it will link almost every city of 50,000 or more population.

Interstate Highways do no more than the Indian trail; they take you from where you are to where you want to be. So what makes them different, except for the sign? Before answering this, let's look at all the country's roads.

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ON THE COVER—Lincoln Memorial, photographed by National Geographic Photographers W. D. Vaughn and John E. Fletcher.

There are 3 1/2 million miles of roads and streets in the United States. City streets account for well over 400,000 miles. More than 2,600,000 miles of the remainder are secondary and local rural roads, ranging from unimproved lanes to all-weather farm-to-market roads. The primary system, including most federal-aid highways and major State roads, totals nearly 400,000 miles. Most of this is the familiar two-lane paved highway, marked by a U. S. number in a black and white shield.

These highways are merely extensions of horse-and-buggy thinking. They are narrow and often crooked. Opposing traffic uses the same slab (with only a white line, or nothing, between). Any property owner may build anything he desires beside the road, put up a mailbox, run a driveway in, and start farming or selling hot dogs or renting billboards to beer companies.

The Interstate System must meet rigid specifications that overcome these drawbacks. As illustrated by Interstate 96 being constructed in Michigan (below), traffic lanes must be 12 feet wide (old average: 10 feet). Opposing traffic (two lanes each way) is divided by median strips of grass 36 feet wide. Shoulders usable by all types of vehicles in all weather extend 10 feet beyond the concrete pavement. Side slopes dip gently to wide ditches and rise beyond to billboard-free fields or forests.

Traffic flows without stopping. The "control of access" feature outlaws intersections (so there is no need for stop lights), private driveways, and roadside establishments of any kind. Side traffic from major crossroads joins the flow at cloverleafs or interchanges. Minor roads cross by overpasses or tunnels and provide no

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TODAY'S HIGHWAYS

Man's biggest construction job

HIGHWAYS ARE NEARLY as old as man—perhaps older, for prehistoric animals had their thoroughfares too. Man and beast naturally beat paths along the lines of least resistance to and from home, water, salt, and hunting grounds.

But the first conscious roadbuilder was the Stone Ager who, tired of walking around a boulder in the path, pushed it aside to save steps.

Today's highway engineers and mammoth construction crews are still pushing boulders out of the way, and the path of the lone Iroquois (left) has become a 300-foot-wide right-of-way serving millions—and costing millions.

Throughout history man has depended on roads, but never has he needed so many so badly. There are traffic jams in Bulawayo, Sevilla, Karachi, and Antofagasta, and each city needs more and better highways into its hinterlands. However, no road-building problem equals that of the United States with its 70,000,000 motor vehicles, and no solution approaches the magnitude of the current American highway construction effort.

The new 41,000-mile Interstate System alone will cost an estimated 40 billion dollars or more—almost a million dollars a mile. It is hard to imagine how much money is involved. The picture below provides one startling comparison. It shows a completed portion of Interstate 70 between St. Louis and St. Charles, Missouri. This 8.3 mile project cost nearly $15,000,000—the amount the United States paid Napoleon for the whole Louisiana Territory (from which Missouri and all or part of 16 other States were carved).

RALPH GRAY, NATIONAL GEOGRAPHIC STAFF; BUREAU OF PUBLIC ROADS, ABOVE

Study the sign in this picture. Perhaps you've seen a similar one on a new highway in your area. It is truly a sign of the times, and of the future, for its red, white, and blue shield designates completed portions of the National System of Interstate and Defense Highways. When you travel by this sign you know that you're

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NATIONAL GEOGRAPHIC PHOTOGRAPHER J. BAYLOR ROBERTS; BUREAU OF PUBLIC ROADS, BELOW

COMMUNING AND COMMUTING—Highways serve nature lovers in Yosemite National Park (above) as well as workaday hordes on the freeways of Los Angeles.

States did not have the means to finance all the surfaced roads suddenly needed. In 1916 Congress enacted the first of several "federal-aid" bills which in effect said "for every dollar any State spends on highways of national importance, the federal government will contribute a dollar." The "matching funds" built the system that veined the nation between world wars.

But the traffic demands of the 50's again swamped the States, and again Congress stepped in with help: the federal government, by terms of the highway act of 1956, would allocate $90 for every $10 spent by the States. It is this 90-10 formula that is today "moving the boulder from the path" and superimposing the Interstate System over our other highways.

The massive construction job, unequaled in the annals of man, had to come, according to one tongue-in-cheek Bible-reading highway engineer. He cited Isaiah's prophecy in the Old Testament: "Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain." R.G.

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BUREAU OF PUBLIC ROADS

access to the superhighway. Farmers travel by these roads to the nearest interchange rather than barging into the stream of traffic at will.

In congested or commercial areas service roads parallel the main highway. All shopping traffic uses them. Rights-of-way measure 300 feet wide or more where frontage roads parallel both sides of an eight-lane divided highway.

Compare such an asphalt aorta with the sluggish artery shown above. This was the Lancaster Pike in 1795, a major highway in its day. It carried wagons and stages between Philadelphia and Lancaster, Pennsylvania, crossing Conestoga Valley. Here the great Conestoga wagons were developed; their rugged boat-shaped bodies proved ideal for heavy freight loads and long distances. In modified form, they carried the westward migration across the Alleghenies, the Plains, and the Rockies.

In colonial times local roads wound from town to neighboring town, and there was no such thing as an over-all system. When a series of such roads happened to connect, then long-distance highways like the Boston Post Road (from New York to Boston) sprang into being. After the Revolution, George Washington preached the necessity of transportation systems to link the States—especially the new trans-Allegheny West with the East Coast. To this end, in 1806, the "National Road" started inching across the mountains from Cumberland, Maryland, to the Ohio River. Wide for its time and largely gravel-surfaced, this highway eventually reached Vandalia, Illinois, and carried a thunderous traffic of Conestogas, stages, and westering pioneers.

In all, the federal government appropriated $3,000,000 for the 600-mile road, but because of the "great expense" Congress got out of the roadbuilding business and did not re-enter it until 1916. Townships, counties, States, and private companies took up the task, often charging tolls for the dubious privilege of bumping over spine-jarring lanes or wallowing axle-deep in mud.

The bicycle, appearing in 1877, is credited with creating a strong demand for smooth roads. In 1893 the first gasoline-powered automobile was operated successfully, but by 1900 there were not more than 150,000 miles of surfaced (usually gravel) rural roads in the United States. Very few stretches of surfacing exceeded five miles in length.

The mass-produced cars of Henry Ford and others quickly changed the picture. Everybody wanted a car and nearly everybody bought one. The

Almost every type of animal big enough for a man to handle has been tagged in one way or another. Not even the mosquito has escaped. He has been sprayed with radioactive mist and his movements traced with Geiger counters. Men have put distinguishing marks on more than half a billion creatures by now.

Although new methods are being developed, marking is an old tool. In the 4th century B.C., Aristotle had fishermen nick the fins of porpoises to learn their life span. As early as 1710, a heron captured in Germany wore metal bands put on its leg by someone in Turkey.

Bird banding, the most widespread system of marking, was first practiced in North America by John James Audubon. In 1804, when Audubon was 19, he put silver wires around the legs of two baby peewees in a cave near Philadelphia. The next year he found the birds nesting near by. A century later systematic work with numbered bands began in the United States. At left, a Baltimore oriole is banded as part of a migration study.

JOYCE SARTWELL

Persons wishing to band birds must apply for a permit, and prove they can identify the local species. Permits are more easily obtained by those wishing to do specific projects than by someone who will just band whatever comes along. Bands are furnished by the federal government, which also gathers the resulting information. When a bird you band is recovered, you are notified. The band is returned to the finder, if he wants it.

To read a numbered band, the ornithologist must have the bird in hand. For sight identification, bright plastic leg bands, neck rings, white feathers attached to plumage, and other tags were devised. Then things got out of control.

Too many people were putting too many trinkets on too many birds. Hunters complained that ducks looked like flying fishermen's hats. One wildfowl experiment came to an abrupt stop when the ducks caught their bills in the neck bands and starved to death.

The United States Fish and Wildlife

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PHOTOGRAPHS BY JOHN AND FRANK CRAIGHEAD

BANDED BIRDS, PAINTED BEARS, PURPLE GEESE

Marked Animals Help American Scientists

YOU STILL WON'T find a purple cow, but would you settle for a purple goose, or a bear with green haunches?

As men delve into the lives of their fellow creatures, sparrows sprout white chicken feathers; trout wear yellow plastic streamers; herrings fly plastic flags from their fins; ducks wear aluminum anklets; and butterflies carry white tags clipped to their wings.

A whale is "shot" with an engraved tube of stainless steel. A squirrel gets a new haircut—a one-inch area of his tail is clipped. Pheasants' feet have radioactive pellets attached so Geiger counters can track them to their nests.

Such markings are identification tags. One of the most easily recognizable "tags" is a dye bath for the whole bird. Snow geese, for example, have been traced in California after being colored pink, green, yellow, or purple. In New York State, biologists have trapped black bears, dosed them with ether, attached numbered ear clips and then, for easy identification in the woods, covered the hindquarters with green enamel.

The National Geographic Society is now sponsoring a study of the West's dwindling grizzly bears. The bear above has been "shot" with a drug-injecting dart gun. The anesthetic knocks out the animal long enough (they hope!) for naturalists to check respiration and blood pressure, and to attach ear tags and plastic streamers for identification.

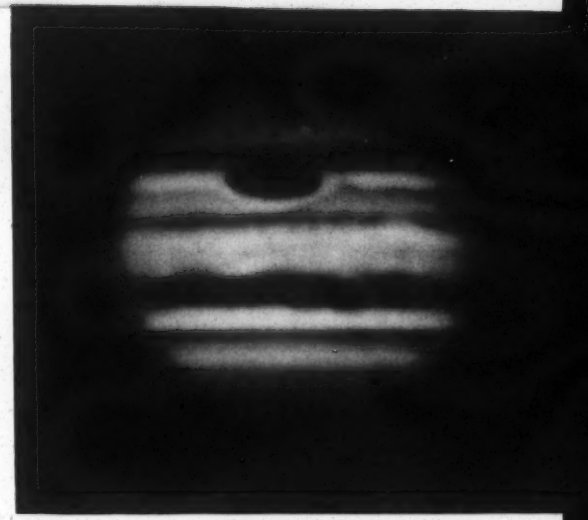
Alaskan bears get different treatment. In a study to determine the extent of salmon fishing by bears, the big bruins were shot from behind with harmless arrows. The tips were vials that broke on impact and splashed the fur with dye.

Such marking (harmless to the creatures involved) is necessary for man to understand the habits, movements, and physiology of his furred and feathered friends. Just as all humans no doubt look alike to animals, man often cannot tell one grizzly from another, or one oriole from another, without some mark of identification.

To learn more about Canada geese, biologists corraled the flock below. Here, the birds are taken with a dip net, examined, leg-banded, weighed in the metal funnel, and finally released. The round-up yields basic knowledge that may help preserve and increase the species.

Solar System No. 6

JUPITER



MOUNT WILSON AND PALOMAR OBSERVATORIES

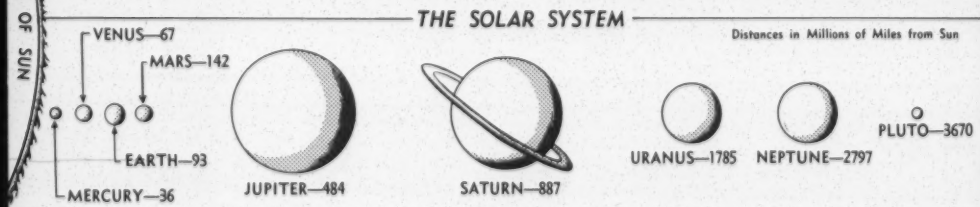
BANDED LIKE a beach ball, mighty Jupiter swings through space—a puzzle wrapped in mystery and coated with enigma.

More massive than all the other planets put together, Jupiter could contain 1,300 Earths. Although it has been the object of fascinated study for centuries, we still know little about it.

There is no difficulty in observing Jupiter. Its bands and four of its twelve moons can be seen with a relatively low-powered telescope or even a pair of binoculars. The rub comes in trying to figure out what it is. Since all we see of Jupiter is its outer husk, studying the planet is like studying an egg by seeing only its shell.

Jupiter's shell, apparently gases with crystals floating in them as water crystals float in Earth's clouds, is broken up into well-defined bands of light and dark. This pattern changes in detail but remains basically the same. Also visible are various other markings, chiefly the "Great Red Spot" which can be seen in the photograph above. The "Spot," which has a surface area as large as Earth's, has been losing the red hue that named it, and now appears grayish. Some astronomers believe it to be a solid body afloat in the atmosphere. They account for its varying visibility by declaring that it rises and falls slightly as it circles among the clouds.

Jupiter spins on its axis faster than any other member of the solar system. Particles at its equator move at a rate of 28,000 miles an hour—28 times as fast as Earth. This



rapid spin bulges the equator, making Jupiter noticeably flat at the poles. The same effect occurs on Earth, though not as strongly.

As might be expected, astronomers differ on what is inside the "egg." Some believe there is a yolk of rock, wrapped in a white of ice. Others declare that the whole planet is gas—the internal sections crushed by enormous gravity into something more similar to metal than to the gases we know on Earth.

It is doubtful that men will ever land on Jupiter to find out. Its atmosphere is poisonous, mostly ammonia and methane. Its bulk, and therefore its gravity, are so huge that it is unlikely that any presently conceivable space ship could take off from its surface, even if it were able to land.

Instead, the best bet for studying the huge planet would be a landing on one of its moons—if the time ever comes when we can voyage the four hundred million miles between them and Earth.

F.S.

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Service, which regulates bird banding, recalled all permits and rewrote them to make plain what they allowed. Special authority was required for use of the color tags. Experiments went forward on a reduced scale.

The perfect mark, not only for birds, but for other animals is the one that is indelible, light, durable, and neither harms nor disturbs the animal. The most common is the aluminum band or tag, which usually lasts as long as the animal does. Birds wear them on their legs, but most mammals won't. Antelope (right), squirrels, rabbits, and deer wear their bands on the ear. Fish have their jaws, gill-flaps, or fins tagged. Members of the Oregon Fish Commission, below, tag a salmon during the fall run into the Columbia River.

From these marking systems, scientists learn a great deal about the behavior of animals. Ohio biologists discovered that muskellunge thrive well enough in a new reservoir to warrant stocking similar lakes. Virginians found that game-farm bobwhites probably did not survive in the wild.

U. S. FISH AND WILDLIFE SERVICE

Salmon tagged in Newfoundland have been hooked two seasons later by fishermen in Norwegian waters. An albacore tagged near Los Angeles swam 5,500 miles across the Pacific. It was caught south of Tokyo.

The "fragile" butterfly braves storms and high winds to travel. A monarch landed in a flower garden in Tyler, Texas, after a flight from Milwaukee, Wisconsin, more than 850 air miles, probably more than 2,000 miles as the butterfly zigzags. Another monarch, banded in Toronto, Canada, came down in San Luis Potosi, Mexico, 1,870 air miles away—some 4,000 butterfly miles (See *Geographic School Bulletins* January 13, 1958).

A hunter in Colombia, South America, shot a pintail duck banded in North Dakota. A weather observer in the northern Cook Islands took another pintail which was banded in northern California only three months earlier. It had flown more than 4,500 miles across the Pacific Ocean.

But the arctic tern is the biggest gadabout. It nests near the Arctic Circle, winters in the Antarctic—a 25,000-mile round trip revealed by banding. L.B.

Near the stone bridge over now-peaceful Antietam Creek, Maryland (right), McClellan exhausted Lincoln's patience. Although the North claimed victory after the capture of Burnside Bridge, McClellan might have won the war on the spot if he had thrown his reserves into the fight or pursued Robert E. Lee and his Southerners.

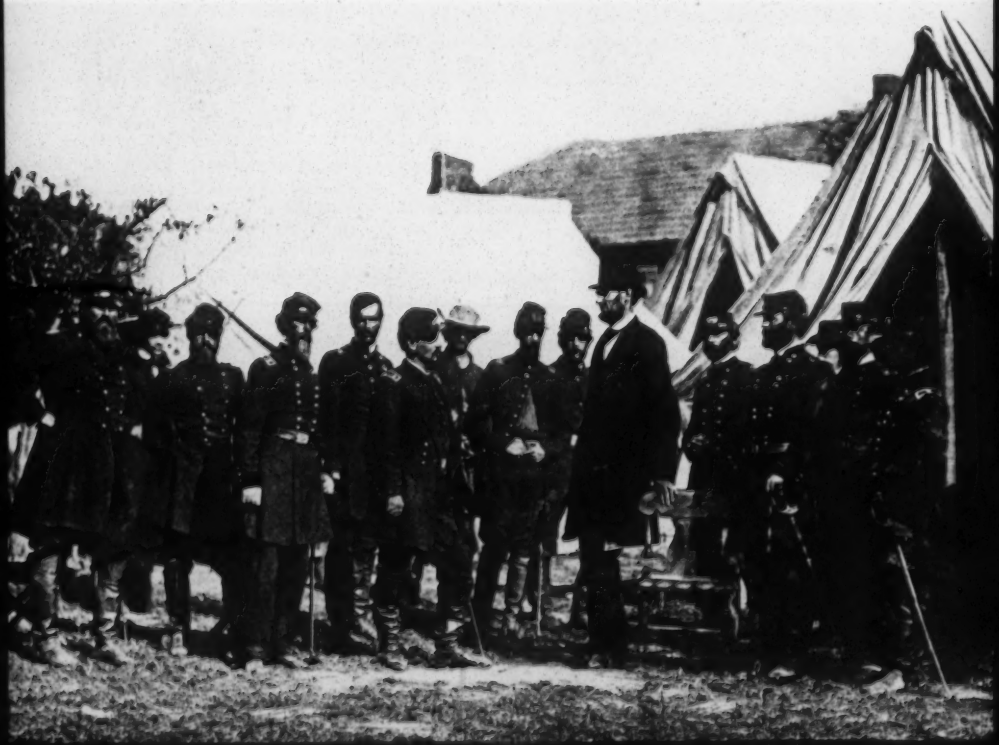
Instead, he stopped to reorganize, and Lee's army lived to fight almost three years longer. The victory, such as it was, did give Lincoln an opportunity to announce his Emancipation Proclamation freeing the slaves. Then he fired McClellan. The two face each other in the Mathew Brady photograph below, taken on the Antietam battlefield.

Other generals did little better and Lincoln paced the White House at night, wrestling with despair.

Then Gettysburg, Pennsylvania, saw a Union victory, and the time of the Confederacy was running out,

NATIONAL GEOGRAPHIC PHOTOGRAPHER W. D. VAUGHN; LIBRARY OF CONGRESS, BELOW

. . . I will hold McClellan's horse if he will only bring us success . . .



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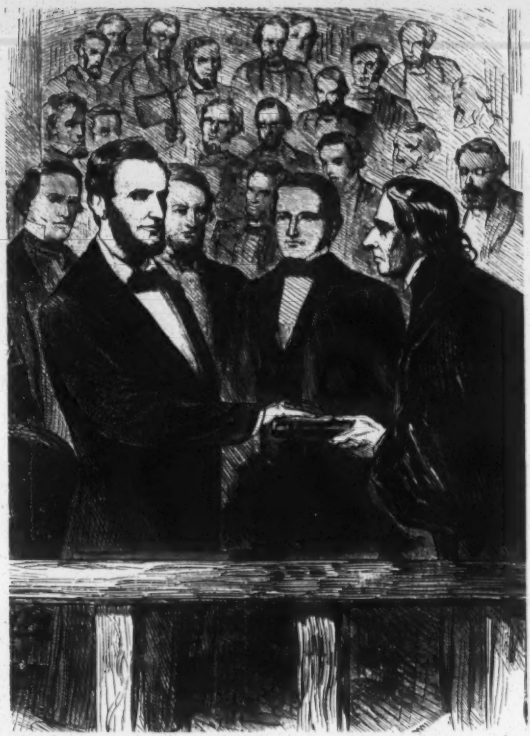
I DO SOLEMNLY SWEAR . . .

With this oath, Lincoln began the fateful war years



THE ILLUSTRATED NEWS, MARCH 16, 1861

"I DO SOLEMNLY swear that I will faithfully execute the office of President of the United States, and will, to the best of my ability, preserve, protect, and defend the Constitution of the United States."

The oath was Abraham Lincoln's; the words those prescribed by the Constitution; the year 1861, when the Constitution needed a great deal of preserving.

The United States was breaking up. Seven slave States had seceded; seven others stood on the brink. Lincoln warned Southerners:

"In *your* hands, my dissatisfied fellow countrymen, and not in *mine*, is the momentous issue of civil war. . . . *You* have no oath registered in Heaven to destroy the government, while *I* shall have the most solemn one to 'preserve, protect and defend' it."

But it was too late for warnings. The guns that would spew death were already loaded; the war was on its way.

The tall, bearded President, looking clear-faced and young in Thomas Nast's drawing of the scene (above) would soon find anxiety etching his face into the brooding, noble visage more familiar to us today.

The war went badly—the first battle, Bull Run, which the Union believed would be an easy triumph for its armies, was a debacle. Congressmen and their ladies journeyed to the battle site with picnic lunches to watch the Northern heroes defeat Johnny Reb. Instead, they found themselves in a rout of Union soldiers fleeing north.

Other defeats followed. The Union's leading general, George B. McClellan, suffered from the "slows." He overestimated the Confederate strength, demanded more men and equipment before attacking.

He also suffered from an exaggerated view of the genius of George B. McClellan. He felt that he should be President instead of the gangling, homespun Lincoln. (He was to try for the job later. The voters disagreed with him.) He treated Lincoln insolently, but Lincoln bore it, and hoped for victories. "I will hold McClellan's horse if he will only bring us success," the President told a White House conference.

McClellan's caution brought only failures. In an effort to get action, Lincoln, as commander-in-chief, took the field himself, and directed land and naval forces in the capture of Norfolk, Virginia.

PAINTING BY FLETCHER C. RANSOME FROM FOREST LAWN MEMORIAL PARK ASSOCIATION; NGS PHOTOGRAPHER W. D. VAUGHN, BELOW

. . . this nation, under God, shall have a new birth of freedom, and . . . government of the people, by the people, for the people, shall not perish from the earth.

although few persons realized it. Lee again escaped, and Lincoln brooded, "The war will be prolonged indefinitely." Successes in the west gave new hope as Lincoln rode to Gettysburg to attend the dedication of the battlefield cemetery. He had been asked to make a "few appropriate remarks."

Like any good writer—and Lincoln was among the best—he worked over his manuscript, editing and revising on a table in the house where he slept (left).

His two-minute speech, he later said, "fell on the audience like a wet blanket." But its timeless cadences, its ringing assertion of democracy's faith, have earned world acclaim.

Finally, the war was over, and a haggard President could relax a little. But there was a dream. In the vision, Lincoln saw a body laid out in the White House, and heard a soldier say "The President . . . was killed by an assassin." Several days later, on Good Friday, 1865, the horrible dream came true. F.S.

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